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Diamonds Used to Detect Atomic Radiation

Radioactivity studies conducted by L. F. Curtiss of the Bureau's radioactivity laboratory have shown that diamonds are highly sensitive to gamma rays and may be used to detect this radiation in the same way as a Geiger-Müller counter. It has been found that a diamond placed in a strong electric field initiates sharp electrical pulses when gamma radiation is absorbed, and, as with a Geiger counter, a count of pulses gives an indication of the intensity of the radiation. The diamond counter has not yet been tested for beta radiation, but it is expected that a similar effect may be observed in this case.

Gamma rays—electromagnetic rays of very short wavelength similar to X-rays—are constantly given off by radioactive materials. Of great value in many lines of research, they are used principally in medicine for treatment of malignancies, in industry for the radiographic examination of metallic castings, and in nuclear physics for the study of the structure and energy levels of the nucleus. Development of the diamond counter provides an important new tool for scientists and technicians in these fields.

To use a diamond as a counter, it is clamped between two small brass electrodes maintained at a difference in potential of about 1,000 volts. When a source of gamma radiation is brought within range of the diamond, there occur across the electrodes pulses of current, which after amplification may be detected and counted on any suitable indicating device, such as an oscilloscope, a current meter, a set of earphones, or a loud speaker. In the apparatus assembled at the Bureau, primary amplification is effected with minimum loss of original intensity through the use of a triode very close to the diamond in the circuit. The output from this tube is then applied to a two-stage amplifier, from which pulses of sufficient magnitude are obtained to operate the detecting instrument.

The pulse-producing property of the diamond is thought to be a result of its highly symmetric crystalline structure, characterized by a very regular arrangement of carbon atoms with relatively large intervening spaces. According to this theory, when a photoelectron is emitted by a diamond atom as the result of the absorption of gamma radiation, the freed electron is accelerated through the interatomic space toward the positive electrode. Within a very short distance it acquires such high velocity that other atoms along its path are ionized by collision with the release of additional electrons, which in turn are accelerated in the same direction. This multiplication of charges repeats itself in rapid succession, producing a sudden avalanche of electrons equivalent to a small pulse of current. The larger the diamond, the more electrons would be involved in the sudden pulse that is counted. This means that the gamma-ray sensitivity of a diamond counter should be proportional to the size of the crystal. However, adequate sensitivity is obtained with a comparatively small diamond. Apparently the diamond quickly recovers from its ionized state, as the pulses registered are extremely sharp. The diamond counter is thus a

very "fast" counter, capable of indicating a much greater number of pulses per minute than is possible with the ordinary Geiger-Müller counter.

Similar principles have been utilized at the Bell Telephone Laboratories in experiments with alpha particles. Here, because of the poor penetration of this radiation, both electrodes were applied to the same crystal face, and the impinging particles were detected by means of the surface ionization they produced.

Although gamma rays may produce photoelectrons in other crystalline substances such as sodium chloride, in most cases the crystal must be cooled to a very low temperature to eliminate background noise, which may be due to continuous ionization of the lattice at ordinary temperatures. The diamond is the only material so far investigated that performs satisfactorily at room temperature.

Flawless Industrial Diamonds Necessary

Industrial diamonds used as counters must be colorless and absolutely free of flaws; about one diamond in forty meets these specifications. Apparently color in a crystal, such as a diamond, indicates a change in the relation of outer electrons to atomic nuclei. Such a condition might tend to inhibit the generation of the required electrical pulse. Obviously, a flaw in the diamond would impede a surge of electrons through the affected portion of the crystal.

Diamonds tested in the Bureau's laboratories have been found to have a sensitivity per unit volume equal to or greater than that of any counter constructed by man. One of these diamonds, measuring about $\frac{1}{8}$ inch

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E. U. Condon, *Director*

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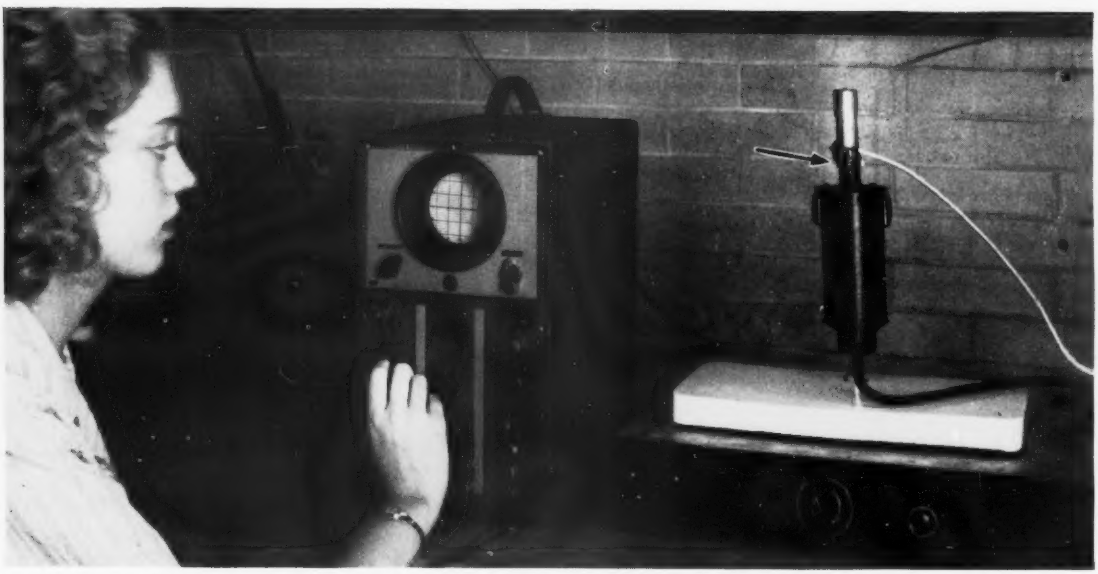


Extremely small intensities of atomic radiation are detected with a diamond radiation counter, similar in action to a Geiger-Müller counter. A colorless industrial diamond, clamped between metal electrodes (indicated by arrow, right), forms the counter. Gamma rays falling on the diamond produce sharp electrical pulses that are amplified and recorded on an oscilloscope or other recording instrument.

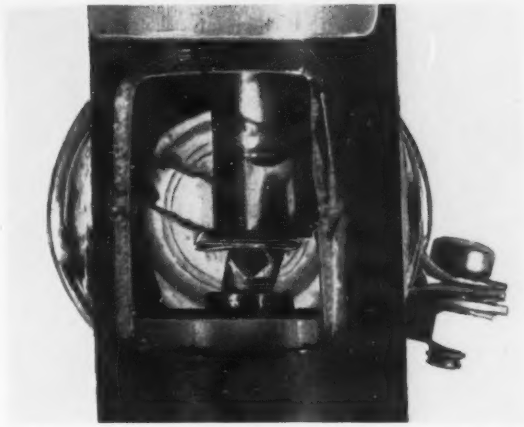
on each face, has approximately the same sensitivity for gamma radiation as a laboratory-constructed Geiger-Müller counter of the usual type. Many diamonds are larger and would thus be much more sensitive.

Long Life for Diamond Counter

The conventional radiation counter lasts from 3 months to 2 years, depending upon how much it is used. A diamond counter, on the other hand, is practically indestructible, although extremely long use might produce discoloration or flaws, with a corresponding loss in sensitivity. There is no appreciable cost difference between the diamond and an ordinary counter. However, one of the important advantages of the diamond counter, in addition to sensitivity and long life, is its small size, permitting use inside the human body or in small openings in industrial equipment.

Alpha, beta, and gamma radiations are important manifestations of the nuclear changes occurring in the disintegration of radioactive isotopes. Prior to the development of the atomic pile, radioisotopes were produced in limited amounts in the cyclotron and other "atom smashers". Now, however, they are obtained cheaply from a chain-reacting pile and in quantities sufficient for extensive use as tracers in medical, biological, and industrial research. Basic to the use of a radioelement as a tracer is the sensitive detection of the presence of such an element by means of the radiation it continually emits. The detection of radioactive emissions is also important in experiments involving nuclear radiation, transmission and disintegration, as well as in safeguarding the lives of those engaged in these projects.

The presence of extremely minute quantities of radioactive material may now be determined by means of the Geiger-Müller counter, one of the most sensitive of scientific instruments, but an increasing demand has resulted in a critical shortage of such equipment. For this reason, many laboratories have found it necessary to construct counters for their own use. In view of the relative abundance and moderate cost of industrial diamonds, as well as the simplicity and apparent indestructibility of the diamond counter, it is probable that Geiger-Müller counters may be replaced by diamond counters for many applications.



A flawless, water-clear industrial diamond is the heart of the diamond radiation counter developed in the Bureau's radioactivity laboratory. Sharp electrical pulses produced within the diamond by absorption of gamma radiation form the basis of the counter.

Cosmic and Solar Radio Noise

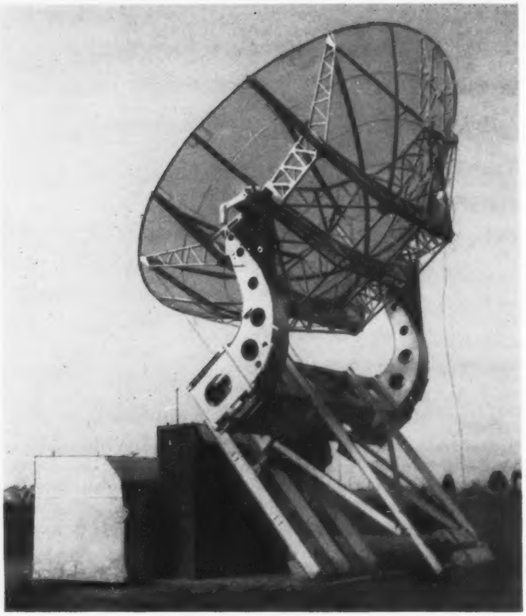
Bureau scientists are initiating a project for the observation and analysis of radio noise generated by the sun, a companion project to cosmic radio noise studies already in progress. The new investigation will seek to determine the range of frequencies broadcast from the sun, received intensities, and the correlation of solar noise with other solar, interstellar, and terrestrial phenomena.

Two giant radar mirrors at the Bureau's radio propagation laboratory at Sterling, Va., will intercept and record solar noise reaching the earth. These devices are particularly suitable for the investigation because of their size. The reflectors, about 25 feet in diameter, allow the capture of a large amount of energy from solar broadcasts. By automatic control, the mirrors will be directed at the sun constantly throughout the day. The first receiver is now in process of installation and will be used, initially, for studies in the 480- to 500-megacycle band.

With the use of higher and higher frequencies in communication and radar equipment, both solar and cosmic noise have come to be recognized as increasingly important. Recent advances in design for both very high- and ultra-high-frequency receivers, which practically eliminate internal set noise, indicate that the limiting factors in the use of the equipment will be those arising from natural phenomena.

Three general types of external noise that affect radio reception are of scientific interest. The first is atmospheric radio noise, or "static" originating within the earth's atmosphere which, with its characteristic crackle and crash, is familiar to every radio listener. This type of noise is actually the reception of radio energy produced by a lightning discharge. Extreme and prolonged static in the North American continent is generated for the most part in the Caribbean and South American thunder storm regions. Individual flashes of lightning not only accumulate to produce almost steady noise, but also are transmitted over long distances in exactly the same fashion as man-made signals.

Atmospheric radio noise ceases to be a major problem above about 15 megacycles, but it is at this frequency that cosmic noise becomes noticeable. Unlike the radio noise of terrestrial origin, cosmic radio noise exists as a low steady hiss. In the case of FM equipment, the FM signal itself tends to suppress this noise



Radar mirrors at the Bureau's Sterling radio laboratory are designed to intercept and record solar radio noise reaching the earth. The 25-foot reflectors are automatically directed at the sun throughout the day.

within a certain range of the transmitting station. However, as distance from the station increases, the ratio between the strengths of the competing signals changes in the favor of cosmic noise until it completely drowns out the FM signal. The main center for the generation of cosmic noise is the constellation Sagittarius in the Milky Way. Because of this, there is a slow change in noise intensity as the position of the earth changes relative to the constellation.

Because of the similarity of the sound produced in the receiver, it has been suggested that cosmic noise may be due to radiation emitted by the thermal agitation of charged particles. The stars of the Milky Way throw off a large amount of material, which expands and tends to fill the intervening space as a very tenuous gas. Under the action of starlight, these atoms of gas are ionized with the production of positively and negatively charged particles, which radiate visible light and may also serve as sources of radio radiation.

Solar noise, which appears at ultra-high frequencies, has a basic component much like cosmic noise—a steady hiss. However, it also has an undulating component superimposed upon the stable noise. These variations are sometimes of great rapidity and manifest themselves in the form of "puffs" and "swishes" lasting a second or less. The swishes may overlap, giving rise to a grinding noise, which may cause streaking on a television screen and picture jumpiness. Intense bursts of solar transmission that last as long as several hours cause a radar to become blind when pointed in the direction of the sun.

In the field of cosmic noise, the two chief problems to be solved are the determination of the intensity-versus-frequency function of the radiation and a more accurate survey of intensity versus position at a variety of frequencies. Both of these problems are being attacked at the Bureau. To investigate the first, a series of measurements are being made over the frequency range from 25 to 110 megacycles by means of a battery of specially designed receivers, each tuned to a particular frequency. The second problem requires the highest possible resolving power, which may be obtained either by going to higher frequencies or by using larger collectors. Both lines of attack are to be employed.

Comprehensive data on radio waves of celestial origin are expected to be useful in several applications. For example, a radio sextant might be built to determine position from the direction of arrival of solar noise. This device would permit navigation by the sun even though the sky is overcast and would have some advantage over loran in that it would be completely independent of ground stations. It may also be possible, by analysis of the direction and intensity of cosmic noise, to study details of the Milky Way that cannot readily be investigated by the astronomer's telescope.

Paints For Masonry Walls

The extensive use of masonry building materials, for which decorative or water-repellent treatment is desirable, has increased the need for more complete information regarding the durability of coatings for masonry surfaces. In general the average householder, and even the professional painter, is not as familiar with masonry paints as with outside house paints. Through advertising and usage, the latter have come to be known not only as to composition but also as to expected performance—particularly their behavior when exposed to weathering. To provide comprehensive data on the large number of paints in the masonry group, exposure tests extending over a 6-year period were made on a number of commercial masonry paints by paint chemists of the National Bureau of Standards. Results of this investigation [1] have provided interested individuals and the building industry as a whole with much-needed information.

In the course of the Bureau's investigations, wall specimens of stone- and cinder-concrete block, lightweight-aggregate block, new and used common brick, and cast-concrete slabs, were coated with cement-water, resin-emulsion, oil-base, and rubber-solution paints. The organic coatings, that is resin-emulsion, oil-base, and rubber-solution paints, were also applied to wood-frame walls faced with cement-asbestos shingles.

[1] Additional details of this investigation are reported in BMS 110, Paints for exterior masonry walls, which will be available shortly from the Superintendent of Documents.

To provide typical masonry surfaces for the tests, several hundred unit walls 2 feet by 2 feet by 8 inches were laid, following the usual technique employed in contract construction, and concrete slabs were made in lacquered-wood forms using a 1: 1: 6 concrete mix. Cement-water paints were scrubbed into these wall surfaces with stiff-bristle scrub or fender brushes, and the organic coatings were applied with regular 4-inch paint brushes.

Prior to painting, some of the walls were given base coats of grout, consisting of equal parts of white portland cement and mortar sand (passing No. 20 mesh sieve) mixed with sufficient water to give a creamy consistency. This base produced a hard continuous coating that improved the painting surface by filling the voids in the block and closing the openings in the mortar joints.

3- and 6-Year Exposure Tests

After the paints were applied to the representative masonry surfaces, the walls were exposed to atmospheric conditions in Washington, D. C., for periods of 3 and 6 years. At the end of these periods, ratings based upon the weathering characteristics and performance of each type of paint were recorded. The results indicate that well-formulated masonry paints, skillfully applied, are durable and that it is possible to maintain painted masonry at minimum cost. The cement-water paints were found to provide a durable as well as decorative coating for exterior walls. Good results were also obtained with oil-base, resin-emulsion, and synthetic-rubber-base paints.

The masonry wall specimens that were exposed for the 6-year period in general showed the same results as those exposed for the 3-year period. The specimens, as painting surfaces, were rated in the following order: (1) New cement asbestos shingle-faced wall specimens; (2) stone-concrete block; (3) cinder-concrete block; (4) new common brick; (5) light-weight-aggregate-concrete block; (6) cast concrete; and (7) used common brick wall specimens.

For cement-water paints, the method of application, the curing, and the conditions under which surfaces are painted are more important than the composition of the paints as long as the portland-cement content of the paint is not less than 65 percent by weight. With the possible exception of cast concrete poured against oiled forms, cement-water paints are satisfactory for the initial painting of new masonry. Further coatings are not necessary, although for improved decorative value, the cement coating can be covered with an exterior masonry oil-base, resin-emulsion, or rubber-solution paint. A synthetic-rubber paint can be applied immediately after the cement-water paint dries, but it is recommended that the cement-water paint be permitted to age for at least

Several hundred wall specimens of the more common masonry constructions, coated with commercial masonry paints and exposed for 3- to 6-year periods, have provided Bureau chemists with comprehensive data on protective coatings for masonry surfaces. A few typical results are illustrated. The concrete-block field office (top center), finished with two coats each of grout and rubber-base paint, served also as a test specimen.

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2 weeks before application of resin-emulsion paints and 3 months before application of oil-base paints. Sharp sand in the cement-water paint, or a priming coat of grout, improves the durability of subsequent organic coatings on open-textured walls or those having cracks or other defects. Pure white portland cement or admixtures of cement and lime will also give good results.

On close-textured masonry or open-textured surfaces that have been moisture-proofed, oil-base paints can be used, although new surfaces of both types should not be painted for 6 to 12 months. Walls must be dry when the paint is applied and so constructed as to remain dry after painting. Applied to a wet wall or one that becomes wet through structural defects, these coatings will fail by scaling and flaking. Oil-base paints usually weather by chalking, a property that makes them self-cleaning and lessens their tendency to discolor or stain.

Base Coat for Open-Textured Surfaces

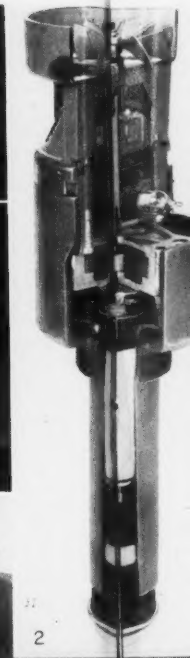
A grout of portland cement and sharp sand gives a good base coat on open-textured surfaces such as stone- and cinder-concrete block, lightweight-aggregate-concrete block, and new and used common brick with untooled joints. The grout should be allowed to set at least 90 days. It may be applied immediately upon erection of the wall or at any time during the aging period of 6 to 12 months.

A protective primer, such as rubber-solution paint, should be used as a first coat over the grout if there is a possibility that the wall is damp or contains soluble salts. One coat of the oil-base paint should give a good finish, although two coats will have greater durability.

Resin-emulsion paints have good decorative qualities and are durable on exterior masonry walls. Open-textured surfaces and brick walls with cracks around the mortar joints should be given a base coat of grout or cement-water paint containing sharp sand. Resin-emulsion paints, which provide good coverage, are easily applied by brush or spray to either damp or dry walls. A minimum of 3 weeks should elapse before painting new masonry walls.

Synthetic-rubber paints come in two types: rubber-emulsion and rubber-solution. They may be applied on either dry or slightly damp wall surfaces but not on wet surfaces, as excessive moisture may prevent adequate bond. The rubber-emulsion paint samples tested by Bureau scientists were received directly from the manufacturer and represented experimental mixes. They are not available commercially.

Rubber-solution paint is similar in composition to oil paint, with rubber resin replacing the synthetic or natural resin in the vehicle. Such a paint may be brushed or sprayed on a surface to form a protective primer, under oil-base or resin-emulsion paint, or a complete covering of two or more coats. Normally, two coats give adequate coverage and good durability. On open-textured surfaces, cement-sand grout should first be applied and allowed to dry from 3 to 6 days. Though rubber-solution paint is especially suitable for coating cement-asbestos shingles or siding, it also gives good service on other masonry surfaces.

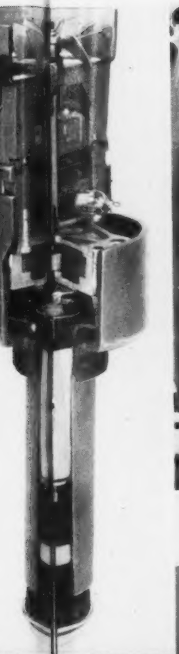


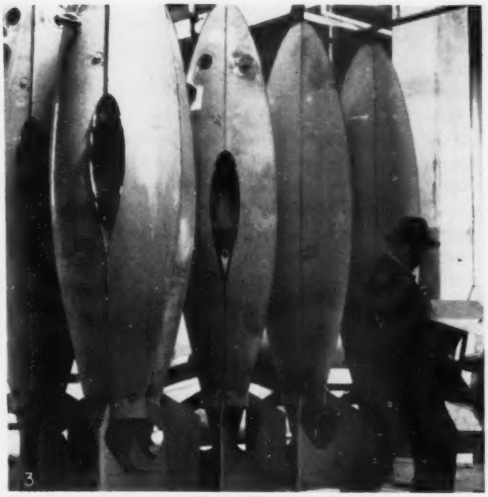
Fighting forest fires by aerial bombing, using fire-extinguishing bom demonstrated as a practical measure by recent tests in which the burea fuel tanks modified by a fuze well in the nose (1) and stabilized with by airborne fire extinguishers dropped from participating aircraft. spraying the extinguishing material over the burning area. (P

Radio Proximity Fuze

Airborne fire extinguishers equipped with the radio proximity fuze appear to offer a rapid and practical means for combating forest fires, according to extensive tests in which the Bureau participated, along with other Government agencies, during the summer. Characteristics of the radio proximity fuze [2] make it particularly adaptable for fire fighting. Because it bursts the fire-extinguishing bomb at the desired height above the ground, it sprays the extinguishing material, which may be water or a fire-smothering chemical, over the burning area. If the bomb does not burst until it hits the ground, nearly half of the material in the bomb remains

[2] See Radio proximity fuze, NBS Technical News Bulletin **31**, 3 (January 1947).





inguishing bombs equipped with the radio proximity fuze (2), was which the bureau cooperated. Bombs were constructed from auxiliary d stabilized with bomb fins (3). Small hot fires (4) were checked (5) ating aircraft. The proximity fuze bursts the bomb above ground, rning ai.. (Photos 1, 3, 4, and 5 from U. S. Forest Service.)

y Fuze in Fire Fighting

in the crater, and the remainder is sprayed over a very narrow area.

The radio proximity fuze, developed at the Bureau during the war, is an extremely small and tough radio sending and receiving station. Immediately upon being released, it begins to transmit radio signals. These signals are reflected back to the fuze from the ground, and when they reach a certain intensity or strength, the receiver triggers an electronic switch that detonates the bomb.

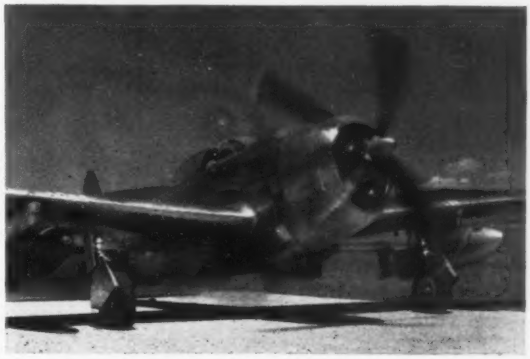
Millions of acres of timber are destroyed each year by forest fires in all parts of the country. In the Northwest forestry area, for example, an average of 1,200 fires are caused by lightning alone during the months of July and August. Many of these occur in remote areas that cannot be readily reached with ordinary fire-fighting equipment. Aerial bombing, successfully carried out, provides a means for checking such fires as soon as discovered and preventing their spread.

The bombs for these tests were constructed from 165-gallon auxiliary fighter fuel tanks stabilized with the 2,000-pound general-purpose bomb fin. A fuze well was installed in the nose, and a burster well extended through the tank. The burster well included a charge to rupture the tank and disperse the extinguishing material after the proximity fuze had functioned.

Fires were purposely started in both brush and dense timber in the mountainous terrain of the Lolo National Forest in northern Montana. A B-29 bomber was used for tests of level bombing and P-47 *Thunderbolts* for dive and glide bombing. Forty-two bombs with proximity fuzes were dropped. Although the containers were not designed for bombing and ballistic data were not available, the accuracy of the bombing, particularly from the B-29, was very good. Improved accuracy, however, should be possible with bombs of known ballistic properties.

Plans for future tests include the use of foam instead of water, which should give a better extinguishing blanket and a better indication of the pattern. Other sizes of bombs will also be used, including a 4,000-pound light-case bomb that holds 260 gallons of foam, and a 500-pound light-case bomb holding 23 gallons; both of these will have proximity fuzes. In addition, tests are to be made with the 100-pound chemical bomb case, with a capacity of 8 gallons of fire extinguishing liquid; these will not be equipped with proximity fuzes.

The tests were conducted cooperatively by the United States Forest Service and Army Air Forces, with the assistance of the National Bureau of Standards representing the Office of Chief of Ordnance. The National Bureau of Standards prepared and furnished specially designed VT fuzes and supervised their assembly and use. Flying was done by AAF and ground operations by USFS, centered at the Army Air Base, Great Falls, Mont., and at Forestry Headquarters for the Northwest Area, Missoula, Mont., respectively.



The P–47 *Thunderbolt*, used for dive and glide bombing of experimental forest fires, carries two airborne fire extinguishers. Fires were purposely started for tests of this equipment. (Photo from U. S. Forest Service.)

A Mechanical Mica Splitter

Mica, a mineral which has excellent insulating and heat-resisting qualities, is used extensively to separate condenser plates, to insulate electrode elements of vacuum tubes and for many other insulating purposes throughout the radio-electronics industry. During the war a study of methods of splitting mica was undertaken at the Bureau to find a more feasible means of producing thin films than the tedious hand method commonly employed. After bulk methods of delamination by physical or chemical treatment failed to provide satisfactory results, efforts were concentrated on developing a mechanical process. The resulting mica splitting machine, developed by D. W. Kessler and R. E. Anderson, of the Building Stone Section, not only promises to speed up the process considerably but will greatly reduce the period required to train skilled splitters.

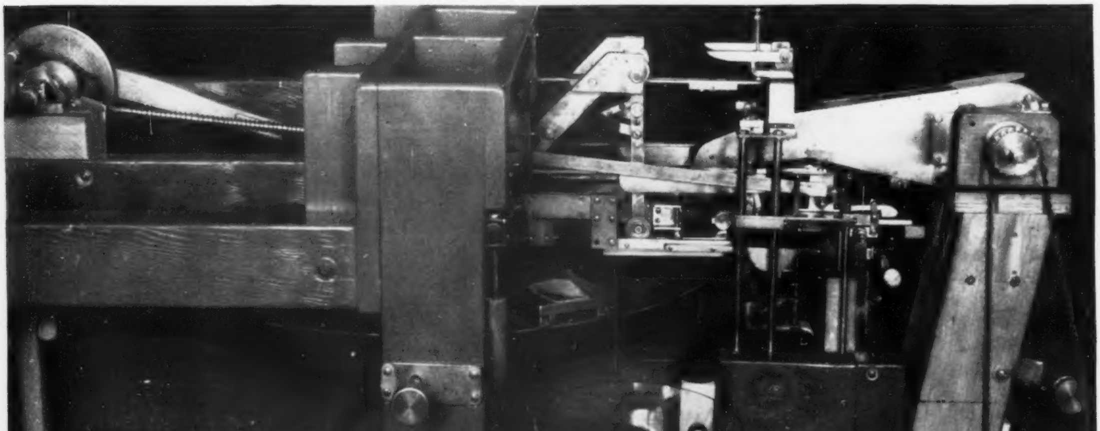
The Bureau's model was designed for small sizes of mica; therefore, a larger machine would be necessary for general use. No claims are made that all problems of machine splitting have been solved by the present machine, but, because of the interest manifested by the industry, details of the various mechanisms are described. Patents have not been secured, so the plans are generally available to mica fabricators.

Because of common mica imperfections such as waviness or unequal spacing of cleavage planes, no precise control of film thickness has been obtained. With a gage setting for 2 mil films a large percentage of the splits will be near the desired thickness, but occasional films may vary as much as 50 percent. The quality of the machine-split films compares favorably with that of hand-split film. It has been found advantageous to retrim one edge of the mica-block with a sharp blade in order to remove the mutilated part caused in the usual trimming process. With the better grades of mica, a greater number of splits near the desired thickness can be obtained. The rate of splitting obtained with this device by an untrained operator was 60 films a minute—a rate that would doubtlessly increase with skill in operation. The average rate of hand splitting is between 15 and 20 films per minute.

Like a hand splitter, the machine starts thin sheets by a sharp point entering one edge of the mica block. The operator, stationed near the dish of mica blocks, places a block on the chuck and turns it under the splitter. The master valve at the center of the turntable connects the chuck to the vacuum line to hold the block in position while it is being split.

On travelling forward, a carriage moves the chuck a short distance, causing the splitter gage to raise a film of mica. As the carriage returns to its starting position, two stripper blades pass under the raised film to separate it from the block. At this stage the free end of the conveyor moves down near the loosened film and draws it to the belt, which carries it to a receptacle.

When one chuck is shifted into the splitting position, another comes before the operator which, when loaded, is ready for shifting. As the turntable locks each time a chuck is in the splitting position, the operator must unlock the latch on his left, hoist the carriage tracks with a foot pedal, and shift the newly loaded chuck until it locks under the splitter.



The mechanical mica splitting machine developed at the Bureau offers a more feasible and accelerated means of producing thin films than the hand method commonly employed. The quality of the machine-split films compares favorably with that of hand-split film and, with the better grades of mica, a greater number of splits near the desired thickness can be obtained.

An accurate comparison has been made of machine split mica films and films produced by an experienced hand splitter to determine differences in quality. Both types showed an occasional thickness variation over different parts of some film, sometimes as much as $\frac{1}{2}$ mil. The variation in thickness of such films is a result of splits tearing across one cleavage to another over part of the surface, believed to be due to crystalline impurities or other defects in the mica. In such cases the torn part that remains attached to the separated film can usually be shaved off with a razor blade. Machine split films, it was found, were less scratched than those split by hand; the path of the knife being easily visible on the latter, and the only scratches on the films produced by the machine were near the edge where the splits were started.

As the mutilated condition of the edges of commercial block mica as a result of the method of trimming interfered considerably with machine splitting, experiments were made to find a method of overcoming this condition. Retrimming the splitting edge with any type of a shearing tool made the splitting more difficult, probably due to the films being crimped together by the shears. However, a means of trimming was found that is fairly satisfactory. The mica block is held on a flat plate with one edge projecting about $\frac{1}{16}$ of an inch. After dipping a thin, sharp blade in water, it is used to trim off the projecting edge of the mica at a slight bevel. The knife is drawn along the edge of the plate with an upward gliding stroke rather than down toward the plate.

Another means of obtaining the same result would be to bevel the edge of the plate on which the mica is held, then cut with a downward stroke of the knife. The bevel should extend back about $\frac{1}{8}$ of an inch from the edge along which the knife is guided so that there will be no support for the mica directly under the cutting edge. This method loosens the films at the edge and improves the splitting. As it requires only 2 or 3 seconds to trim a block, the operator of the machine could trim each block before mounting it on the chuck during the interval between shifts. This would be advantageous, because mica splits easier while it is wet.

A rather common defect in mica is the presence of crystalline impurities. Often these crystals are so small that they do not interfere with splitting, though sometimes they pierce several films and pin them together. As such inclusions give trouble in machine splitting, efforts were made to improve the splitting in these cases. Making the stripper blades thicker so that the films would be bent upward sharply was investigated but was not found very effective. An occasional prying action similar to that applied during hand splitting indicated considerable merit, though mechanical difficulties prevented a thorough trial of this action. The use of an electromagnet to obtain a rapid vibration of the stripper might prove effective in solving this difficulty.

Thirty-third National Conference on Weights and Measures

The establishment of a Weights and Measures Office at the National Bureau of Standards and plans for an advanced training course for State and local weights and measures officials were announced by Dr. E. U. Condon, Director of the Bureau of Standards and president of the Conference, at the 33rd National Conference on Weights and Measures, held in Washington, D. C., from September 22 to 25th.

The National Conference is an organization of State and local weights and measures officials, meeting under the sponsorship of the Bureau of Standards. The annual meetings, first held in 1905, serve as a clearing house for weights and measures information. Uniform specifications, regulations, and enforcement practices that are recommended for promulgation in the States are developed by the delegates to the Conference. More than 250 officials, representing 27 States, attended the conference this year.

The new Office of Weights and Measures, which will be part of the office of the Director of the Bureau of Standards, is to correlate the relations of the Bureau with State and local officials. It will be responsible for developing and maintaining the general service that the Bureau should render to these officials. The office will issue the amendments (adopted at conferences) to the model State weights and measures law and also the revision sheets for the publication, "Specifications, Tolerances, and Regulations for Commercial Weighing Devices." A new edition of the Bureau publication on Federal and State laws relating to weights and measures is to be prepared. R. W. Smith, since 1940 the secretary of the conference, has been appointed chief of the new office. Mr. Smith has previously been Assistant Executive Officer of the Bureau of Standards.

Responsibility for the regulation of weights and measures resides in each of the 48 States—it has never been delegated to the Federal Government. The function of the Bureau of Standards is advisory only. Regulatory power in related matters on the Federal level is vested in the Federal Trade Commission and the Food and Drug Administration, who are responsible for such matters as fraudulent advertising, misbranding, etc., involving goods moving in interstate commerce.

The Bureau of Standards does, however, have direct scientific ties to the State weights and measures administrations through its custody of the Nation's fundamental standards of physical measurement. Because of this, it is the logical place for an advanced training school for State and local officials, who have pressed the need of training facilities for some time. Provisional plans call for a course of 10 days in which the officials will be given advanced training through lec-

tures and laboratory work in the testing and calibration of the basic equipment used in this field.

Main problems tackled by the 33rd Conference were the problem of frozen food packaging, the problem of vehicle tanks used to carry petroleum products, weighing devices, and a symposium on the distribution of liquefied petroleum gases.

As in past years, the need for standard packaging was noted by several speakers. The growing use of odd weights or odd shaped containers was emphasized and the statement made that probably most buyers, in deciding upon one of a number of competing products, judge by the size of the package. Speakers pointed out that the average mathematician, much less the average housewife, would have to use pencil and paper to determine whether a 12½ ounce box of a particular item at 17 cents was a better buy than a 10 ounce box at 14 cents.

The main work of the conference was directed to specific present-day problems with which the official, in his capacity as a referee between buyer and seller, must deal. Matters for discussion were placed on the program through the five standing committees of the conference: (1) Specifications and Tolerances, (2) Methods of Sale of Commodities, (3) Legislation, (4) Weights and Measures Education, and (5) Trading by Weight.

At each conference a number of recommendations are adopted dealing with specific weights and measures practice. These recommendations, which are often the product of conference discussion over several years, are in almost all cases recognized as "standard" and are usually incorporated in State and local regulations, laws, and ordinances. In order that "equity may prevail", all interested parties, including the representatives of industries concerned, are given advance copies of material to be placed before the conference for action. As in the past, major problems were first discussed by means of symposia, and then opened for discussion on the floor.

Porcelain Enamel Adherence Tester

Porcelain enamel must adhere well to the base metal in order to perform satisfactorily in service. The degree of adherence has long been considered an important criterion of the quality of an enamel ground coat. An instrument by which this property may be evaluated through a simple measurement has been designed by Allen C. Francisco, Research Associate of the Porcelain Enamel Institute at the National Bureau of Standards. The apparatus, designed to measure enamel-to-metal adherence electrically, promises to replace the visual estimate method now commonly used and appears adaptable to other types of nonplastic coatings.

The evaluation of adherence is usually made by a visual estimate of the amount of bare metal exposed within a given area on an enameled metal specimen after it has been deformed in a specified manner. The deformation is effected by placing the specimen over a circular die and applying force to a spherical head centered over the die. The elastic limit of the base metal is exceeded and a permanent depression of predetermined dimensions is formed in the specimen. The estimated amount of bare metal, expressed as a percentage of the test area, is used to place the enamel in one of several broad classifications.

Various attempts to secure a precise method of classification have involved the use of ferroxyl indicator gels, resistance measurements of a cell in which the specimen formed one electrode, reflectance measurements, and microscopic analysis of the deformed area. Such methods were not adopted, however, because of the difficulty in controlling variables, or, in some cases, the time required for making a classification.

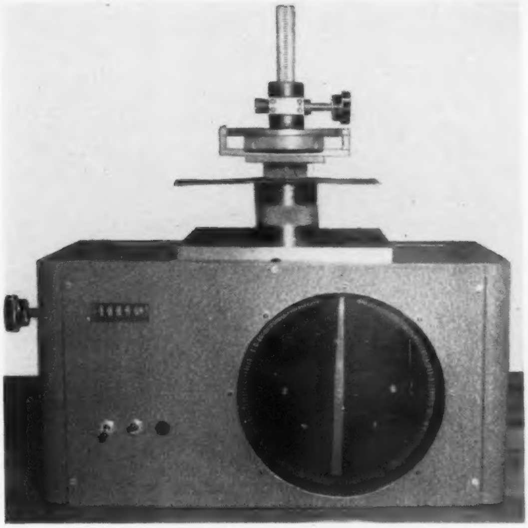
Normally, a porcelain enamel coating is an electrical insulator. The basic principle of the new instrument depends on the completion of an electric circuit through the metal of the deformed specimen to a steel probe touching the test area. By using a large number of probes, and counting the number that conduct a current during the test, an estimate can be obtained of the area that has been exposed.

The test instrument consists of three major parts: the stand, test head, and control cabinet. The stand has a base plate, specimen holder and vertical shaft on which the test head may be raised and lowered. For use on large, flat areas, the specimen holder may be removed, the stand placed in any desired location on the specimen, and the head lowered to make contact with the surface on which the stand is placed.

The test head is made up of a plastic block pivoted to a metal support plate. The elevating mechanism for vertical movement is also attached to the support plate. The plastic block contains 169 holes, arranged in a hexagonal, close-packed pattern, the distance between centers being 0.100 inch. Each hole is fitted with a probe-bearing assembly, which is free to move vertically against a beryllium copper spring. This spring makes an electrical contact between the probe assembly and a wire connected to an individual segment of the selector switch located in the control cabinet.

The steel probes can be lowered onto slightly different locations of the same test deformation by pivoting the plastic block from one to another of five stop positions spaced 7½ degrees apart. As the pivot of the test head is located eccentrically with respect to the test deformation, the center of rotation is different from that of the concentric circles of enamel and bare metal generally found on the deformed area. In this way the possibility of any one probe following the same circular fracture is minimized, and the multiple count for the five stop positions increases the precision of the measurement.

The control cabinet contains a power supply, relay, selector switch, and magnetic counter. In operation, a ground wire is clipped to the specimen to be tested, and the test head lowered onto the deformed area that has



The test head of the adherence tester contains 169 steel probes. Each probe that touches exposed metal actuates a counter; those that touch enameled surfaces do not register. A measure of adherence of porcelain enamel to metal is thus provided.

been positioned below it with the aid of a guide, until all of the probes make contact with the specimen. A synchronous motor drives the selector switch, and the circuit through each probe is tested individually as the arm rotates. The test cycle, started manually, is stopped automatically after the last circuit is tested. For each needle that touches bare metal, the relay actuates the magnetic counter.

The number recorded on the counter may be used for direct comparison of two specimens or, if desired, the exposed and coated portions of the test area may be readily computed, and the coated fraction used as an index of adherence.

Additional developmental tests by the research fellowship are under way in cooperation with those laboratories planning to acquire the adherence tester. Any necessary or desirable modifications suggested by the results of these tests will be incorporated into the design of the apparatus prior to its final form for general use.

New Standard Samples of Hydrocarbons

At the beginning of each quarter, additional new NBS standard samples of hydrocarbons are made available through a cooperative arrangement between the Bureau and the American Petroleum Institute. Seven new compounds announced on October 1 are listed in the accompanying table. One hundred twenty-six of these hydrocarbon samples have now been issued for calibrating analytical instruments and apparatus in the research, development, and analytical laboratories of the petroleum, rubber, chemical, and allied industries. A complete list of NBS standard samples of hydrocarbons may be obtained from the National Bureau of Standards, Washington 25, D. C.

NBS sample number [a]	Compound	Amount of impurity [b]	Volume per unit [c]	Price per unit
		Mole percent	*ml (liquid)*	
523-5S	1,2-Diethylbenzene	0.05±0.03	5	$35.00
525-5S	1,4-Diethylbenzene	.07 ± .02	5	35.00
531-5S	3-Methyl-1-pentene	.30 ± .20	5	35.00
533-5S	2-Methyl-2-pentene	.09 ± .05	5	35.00
534-5S	*cis*-3-Methyl-2-pentene	.15 ± .08	5	35.00
545-5S	2,4,4-Trimethyl-1-pentene	.09 ± .03	5	35.00
546-5S	2,4,4-Trimethyl-2-pentene	.08 ± .05	5	35.00

[a] The designation "-5S" following the sample number indicates a sample of 5 ml sealed "in vacuum" in a special Pyrex glass ampoule with internal "break-off" tip.

[b] The purity has been evaluated from measurements of freezing points, as described in J. Research NBS **35,** 355 (1945) RP1676, unless otherwise indicated.

[c] Tolerance approximately ±10 percent.

NBS Scientists

Dr. Walter Ramberg, a member of the engineering mechanics laboratory staff for over 15 years and chief of that section since 1946, has been designated Chief of the Bureau's Mechanics Division. Dr. Ramberg has conducted extensive research on aircraft structures, particularly as related to strength and stability of structural elements. The vacuum tube acceleration pick-up, most recent of several instruments developed by Dr. Ramberg, capitalizes on the internal vibration of a vacuum tube to measure changes in acceleration of vibrating parts of an aircraft in flight.

Dr. Ramberg succeeds **Dr. Hugh L. Dryden** as chief of the division. Dr. Dryden, who was also an Associate Director, has left the Bureau to become Director of Research for the National Advisory Committee for Aeronautics. His research work has centered in the general field of aerodynamics, in which he has made important contributions to the understanding of wind pressure on structures, properties of air foils at high speeds, and the nature of air turbulence. During the war, Dr. Dryden played an important part in development of the BAT, the only successful guided missile used by any combatant.

Simon H. Ingberg, Chief of the Fire Resistance Section since 1920, retired recently after more than 30 years of Bureau service. Active in the field of fire protection, Mr. Ingberg directed research and introduced experimental techniques that have been responsible for placing fire protection, formerly a rule-of-thumb subject, upon a scientific and mathematical basis. This work included studies of fire severity within buildings and behavior of structural columns during a fire. Among other investigations under his direction were flameproofing of textiles, chimney and roof constructions, and fire-resistive properties of building materials and constructions.

Manual of Instructions for Radio Predictions

Instructions for the use of the Bureau's monthly periodical, "Basic Radio Propagation Predictions—Three Months in Advance" (CRPL Series D), have been prepared in the form of a separate manual that is now available as NBS Circular C465. The purpose of this manual is to explain how the monthly predictions may be used in calculations of usable and working frequencies for sky-wave transmission. Maximum usable frequencies and optimum working frequencies may be computed over any path for any time of day during the month in question. Prediction charts are included for two recent months and sample problems are given for four paths, with a discussion of differences in results because of length of path, the ionosphere layer controlling reflection, season of the year, and degree of solar activity. An attempt is made to emphasize that the most important case of all, namely, transmission by the F2 layer over a transmission path more than 4,000 km in length, can be calculated in a very simple manner. The pamphlet also contains other useful data, including tables, charts, and specimen work sheets. Circular C465 may be obtained from the Superintendent of Documents at 25 cents a copy. The subscription rate to Basic Radio Propagation Predictions is $1 a year (foreign, $1.25), single copies, 10 cents each.

NBS Publications

Periodicals [3]

Journal of Research of the National Bureau of Standards, volume **39**, number 4, October 1947. (RP1829 to RP1834, inclusive).

Technical News Bulletin, volume **31**, number 10, October 1947. 10 cents.

CRPL–D38. Basic Radio Propagation Predictions for January 1948. Three months in advance. Issued October 1947. 10 cents.

Nonperiodical

Research Papers [3,4]

RP1823. Shunts and indicators for surge current measurements. John H. Park.

RP1824. Validity of the cosine-fourth-power law of illumination. Irvine C. Gardner.

RP1825. Acid-base reactions in benzene and other organic solvents: Behavior of bromphthalein magenta with different classes of organic bases. Marion Maclean Davis and Priscilla J. Schuhmann.

RP1826. Observations on the control of grain size in magnesium casting alloys. Vernon C. F. Holm and Alexander I. Krynitsky.

RP1827. Acceptance sampling by variables, with special reference to the case in which quality is measured by average or dispersion. John H. Curtiss.

RP1828. Freezing points of cobalt and nickel. Milton S. Van-Dusen and Andrew I. Dahl.

Circulars [3]

C465. Instructions for the use of basic radio propagation predictions. 25 cents.

Commercial Standards [3]

CS20–47. Staple vitreous china plumbing fixtures. (Supersedes CS20–42). 10 cents.

CS90E–47. Power cranes and shovels, convertible full-revolving type; crawler, truck, and wheel mounted; including clamshell, dragline, lifting crane, hoe, pile driver, and skimmer scoop operating equipment (export classifications). (Supersedes CS90E–41). 15 cents.

Simplified Practice Recommendations [3]

R184–47. Iron valves (gate, globe, angle, and check). (Supersedes R184–42). 5 cents.

R224–47. Medical and surgical hypodermic needles (for hospital use). 5 cents.

R226–47. Standard-grade galvanized ware. 5 cents.

Letter Circulars [5]

LC876. Effect of support on the performance of vane anemometers.

LC877. Electrical characteristics of dry cells and batteries. (Supersedes LC677).

LC878. List of commercial standards, revised to October 1, 1947. (Supersedes LC853).

LC879. Selection, installation, and care of linoleum.

Articles by Bureau Staff Members in Outside Publications [6]

Instrumentation for flight testing airplanes. W. G. Brombacher. Instruments (1117 Wolfendale Street, Pittsburgh 12, Pa.) **20**, 700 (August 1947).

Printed circuits for hearing aids. Edith L. R. Corliss. The Volta Review (Volta Bureau, 1537 Thirty-fifth Street, N. W., Washington 7, D. C.) **49**, 405 (September 1947).

Measurement of electromotive force of a microphone. J. Acoustical Society of America (American Institute of Physics, 57 East Fifty-fifth Street, New York 22, N. Y.) **19**, 503 (May 1947).

Aluminum utensil trade aided by commercial standardization. William H. Jackett, Jr. Domestic Commerce **35**, No. 8, 23 (August 1947).

Issues supplement to Directory of Commodity Specifications. Paul A. Cooley. Domestic Commerce **35**, No. 9, 30 (September 1947).

Survey of proximity fuze development. Chester H. Page and Allen V. Astin. American Journal of Physics (American Institute of Physics, 57 East Fifty-fifth Street, New York 22, N. Y.) **15**, No. 2, 95 (March–April 1947).

Report on standard samples for spectrochemical analysis, 1947. Charles H. Corliss. American Society for Testing Materials (1916 Race Street, Philadelphia 2, Pa.). 30 pages (1947).

Visibility measurements by transmissometer. C. A. Douglas. Electronics (332 West Forty-second Street, New York 18, N. Y.) **20**, 106 (August 1947).

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[3] Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington 25, D. C. Annual subscription rates: Journal of Research, $4.50 (foreign $5.50); Technical News Bulletin, $1.00 (foreign $1.35); Basic Radio Propagation Predictions, $1.00 (foreign $1.25). Single copy prices of publications are indicated in the lists.

[4] Reprints from September Journal of Research.

[5] Available on request from the National Bureau of Standards, Washington 25, D. C. Letter Circulars are prepared to answer specific inquiries addressed to the Bureau, and are sent only on request to persons having a definite need for the information. The Bureau cannot undertake to supply lists or complete sets of Letter Circulars or send copies automatically as issued.

[6] These publications are not available from the Government. Requests should be sent direct to the publishers.

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